In WO 95/16259, Janse discloses, a noise reduction scheme combining a Zelinski system with spectral subtraction, based on speech signals recorded via several microphones. The power spectrum of the noise is estimated during the speech pause segment. The power spectrum of the noise and speech is estimated during the speech period. The signal power spectrum is then obtained by subtracting the noise power spectrum from the combined noise and speech power spectrum. Then the optimal Wiener filter coefficients are calculated accordingly. Noise reduction is achieved through filtering the noisy signal using the Wiener filter.

In US 56190944, Mau et al discloses a a novel structure for a filter-bank. In the context of filter-bank technology, a signal is segmented into a number of sub-bands. After processing of each sub-band, the original signal is reconstructed. The signal reconstruction, however refers to the process of synthesizing the segmented signals. This involves parallel processing of each sub-band signal through over-sampling, digital filtering, and synchronous summing. The purpose of reconstruction is to obtain the original signal.

In US 6298050, van Heeswket al discloses a technique to remove the interference from a high power user. The transmitted signal from the interfering user is first detected. Then the interference is reconstructed by passing the decision through the air-interface model. The reconstructed interference is finally subtracted from the composite received signal, thus improving the signal-to-interference ratio of the other users on the system. The method is used preferably when the power of the interfering user is sufficiently high to allow successful detection.

In US 6426983, Rakib et al discloses an invention for eliminating narrow band interference present in broadband digital data communication systems. The narrow band interference excision circuit comprises a bank of analysis filters and a bank of synthesis filters separated by an excision circuit. The analysis filters function to divide the input signal into a plurality of narrow sub bands. A threshold is set to detect whether there exists interference in one or more sub bands. Once detected, the signal on the sub bands will be erased or suppressed by the excision circuit. Then, a bank of polyphase synthesis filters reassembles the composite signal.

Responsive to the Authorized Officer's Novelty Objections of Claims 1 to 36 as filed, Applicants have amended claim 1,19, 25 and 31 as filed to incorporate limitations of claims 2 and 7. Applicants wish to further emphasize the limitations whereby identification of the one or more signal components based upon a channel estimate of the plurality of signal components and the reconstructing to provide a reconstructed transformed signal of the transformed signal.

Applicants respectfully submit that the cited art do not disclose the method of the claimed invention and particularly with the identification of the one or more signal components based upon a channel estimate of the plurality of signal components and the reconstructing to provide a reconstructed transformed signal of the transformed signal.

Applicants respectfully disagrees with the authorized officer and submits that the cited prior art do not disclose nor anticipate the claimed invention as taught in claim 1 as amended. Applicants submit that while the prior art are in the field of signal interference suppression and reconstruction, the claimed invention is not only unanticipated but in a different field. Accordingly, Applicant request that the Novelty objection of claim 1,19, 25 and 31 as filed be withdrawn.

In the FIRST Written Opinion dated 19th Dec 2003, the Authorized Officer has objected to Claim 1 to 36 for lack of Inventive Step citing WO95/16259 by Janse, US 56190944 by Mau et al, US 6298050 by van Heeswket al and US 6426983 by Rakib et al. The authorized officer has also further emphasized page 2 line 32 to page 8 line 24 of WO95/16259.

In WO 95/16259, Janse discloses, a noise reduction scheme combining a Zelinski system with spectral subtraction, based on speech signals recorded via several microphones. The power spectrum of the noise is estimated during the speech pause segment. The power spectrum of the noise and speech is estimated during the speech

period. The signal power spectrum is then obtained by subtracting the noise power spectrum from the combined noise and speech power spectrum. Then the optimal Wiener filter coefficients are calculated accordingly. Noise reduction is achieved through filtering the noisy signal using the Wiener filter.

In US 56190944, Mau et al discloses a novel structure for a filter-bank. In the context of filter-bank technology, a signal is segmented into a number of sub-bands. After processing of each sub-band, the original signal is reconstructed. The signal reconstruction, however refers to the process of synthesizing the segmented signals. This involves parallel processing of each sub-band signal through over-sampling, digital filtering, and synchronous summing. The purpose of reconstruction is to obtain the original signal.

In US 6298050, van Heeswket al discloses a technique to remove the interference from a high power user. The transmitted signal from the interfering user is first detected. Then the interference is reconstructed by passing the decision through the air-interface model. The reconstructed interference is finally subtracted from the composite received signal, thus improving the signal-to-interference ratio of the other users on the system. The method is used preferably when the power of the interfering user is sufficiently high to allow successful detection.

In US 6426983, Rakib et al discloses an invention for eliminating narrow band interference present in broadband digital data communication systems. The narrow band interference excision circuit comprises a bank of analysis filters and a bank of synthesis filters separated by an excision circuit. The analysis filters function to divide the input signal into a plurality of narrow sub bands. A threshold is set to detect whether there exists interference in one or more sub bands. Once detected, the signal on the sub bands will be erased or suppressed by the excision circuit. Then, a bank of polyphase synthesis filters reassembles the composite signal.

Applicants submit that the present invention as claimed by claim 1, 19, 25 and 31 as amended teaches noise reduction in a transformed signal having a plurality of signal components, where one or more signal components of the plurality of signal

components are identified, based upon a channel estimate of the plurality of signal components, and the one or more signal components are reconstructed to provide a reconstructed transformed signal of the original transformed signal.

The cited art does not teach such noise reduction using the techniques in the claimed invention. In WO95/16259 the power spectrum of the noise is estimated during the speech pause segment. The power spectrum of the noise and speech is estimated during the speech period. The signal power spectrum is then obtained by subtracting the noise power spectrum from the combined noise and speech power spectrum. Then the optimal Wiener filter coefficients are calculated accordingly. Noise reduction is achieved through filtering the noisy signal using the Wiener filter.

In US 5610944, a filter bank is used to segment a signal into a number of sub-bands. After processing of each sub-band, the original signal is reconstructed. The signal reconstruction, however refers to the process of synthesizing the segmented signals. This involves parallel processing of each sub-band signal through over-sampling, digital filtering, and synchronous summing. The purpose of reconstruction is to obtain the original signal not a transformed signal of the original signal having reduced noise.

In US 6298050, interference from a signal is reconstructed by passing an air-interface model. The reconstructed interference is finally subtracted from the received signal, thus removing the interference and improving the signal-to-interference ratio of the other users on the system.

In US 6426983, narrow band interference present in broadband digital data communication systems is eliminated using an excision circuit compriseing a bank of analysis filters and a bank of synthesis filters. The analysis filters divide the input signal into a plurality of narrow sub bands. A threshold is set to detect whether there exists interference in one or more sub bands. Once detected, the signal on the sub bands will be erased or suppressed by the excision circuit. Then, a bank of polyphase synthesis filters reassembles the composite signal. There is again no reconstruction of the transformed signal into a reconstructed transformed signal with reduce noise.

Applicants respectfully submit that the cited art does not anticipate nor teach the claimed invention. Applicants respectfully request the Authorized Officer to withdraw the lack of inventiveness objections of claim 1, 19, 25 and 31 as amended.

Therefore, in view of the amendments to the claims and the comments hereinabove, it is respectfully submitted that amended and renumbered Claims 1, 17, 23 and 29 are in an allowable state. Applicants further submit that renumbered dependent claims 2-16, 18-22 and 29-34 are allowable for at least the same reasons as amended and renumbered Claims 1, 17, 23 and 29.

The Applicant further submits that no new matter has been added to the application by these amendments.

The Applicant respectfully submits that the earlier amended Claims do overcome the Authorized Officer's objections. In view of the above, the Applicant respectfully submits that the present application is in condition for allowance. Reconsideration of the present application and a favorable response are respectfully requested.

Respectfully submitted,

Date : 11 Nov 2004

Adrion YAP

Claims

1. In a receiver of a communication system, a method for reducing noise in a transformed signal, said transformed signal having a plurality of signal components, said method comprising the steps of:

    receiving a transformed signal by a detector of said communication system;

    processing said transformed signal; and

    reconstructing a predetermined number of times, by a reconstructing module, one or more signal components of said plurality of signal components, said reconstructing being based upon said processing step to thereby reduce noise in said transformed signal~~.~~;

    wherein said processing step further comprises the steps:

    identifying said one or more signal components based upon a channel estimate of said plurality of signal components; and

    further wherein said reconstructing step further comprises the step of providing a reconstructed transformed signal of said transformed signal.

~~2.The method as claimed in Claim 1, wherein said processing step comprises the step of identifying said one or more signal components based upon a channel estimate of said plurality of signal components.~~

2. The method as claimed in Claim 1, wherein said processing step comprises the step of providing an estimated signal from said transformed signal at output of said detector and based upon said channel estimate.

~~4.~~3. The method as claimed in Claim ~~3~~2, wherein said processing step further comprises the step of decision processing said estimated signal using a plurality of decision modules.

~~5.~~4. The method as claimed in Claim ~~4~~3, wherein said decision processing step comprises the step of soft decision processing.

~~6.~~5. The method as claimed in Claim ~~4~~3, wherein said decision processing step comprises the step of hard decision processing.

~~7. The method as claimed in Claim 4, wherein said reconstructing step comprises the step of providing a reconstructed transformed signal of said transformed signal~~

~~8.~~6. The method as claimed in Claim ~~7~~1, wherein said reconstructing step further comprises the step of providing another estimated signal from said reconstructed transformed signal at said output of said detector and based upon said channel estimate.

~~9.~~7. The method as claimed in Claim ~~8~~6, wherein said processing step further comprises the step of decision processing said another estimated signal using said plurality of decision modules.

~~10.~~8. The method as claimed in Claim ~~9~~7, wherein said decision processing of said another estimated signal comprises the step of soft decision processing.

~~11.~~9. The method as claimed in Claim ~~9~~7, wherein said decision processing of said another estimated signal comprises the step of hard decision processing.

~~12.~~10. The method as claimed in Claim ~~9~~7, wherein said reconstructing step further comprises the step of determining whether said one or more signal components has been reconstructed said predetermined number of times

~~13.~~11. The method as claimed in Claim ~~12~~10, wherein said reconstructing step further comprises the step of determining whether to process another one or more signal components of said plurality of signal components.

~~14.~~12. The method as claimed in Claim ~~13~~11, and further comprising the step of providing current estimated signal for subsequent processing when determined that iteration of said another signal component is not required.

~~15.~~13. The method as claimed in Claim ~~13~~11, wherein said reconstructing step further comprises the step of simultaneously reconstructing two or more of said another one or more signal components.

~~16.~~14. The method as claimed in Claim ~~13~~11, wherein said reconstructing step further comprises the step of reconstructing, one at a time, each of said another one or more signal components.

~~17.~~15. The method as claimed in Claim 1, wherein said reconstructing step further comprises the step of simultaneously reconstructing two or more of said one or more signal components.

~~18.~~16. The method as claimed in Claim 1, wherein said reconstructing step further comprises the step of reconstructing, one at a time, each of said one or more signal components.

~~19.~~17. A receiver for reducing noise in a transformed signal, said transformed signal having a plurality of signal components, said receiver comprising:

a signal reconstructing section having:

a detector for detecting said transformed signal;

one or more decision modules, each of said one or more decision modules having an input coupled to output of said detector; and

a reconstructing module having one or more inputs, said one or more inputs being respectively coupled to output of said one or more decision modules,

wherein said reconstructing module is adapted to reconstruct one or more signal components of said plurality of signal components a predetermined number of times to thereby form a noise-reduced transformed signal~~.~~; and

wherein said reconstructing module is adapted to provide a reconstructed transformed signal of said transformed signal;

further wherein said reconstructing module is adapted to identify said one or more signal components based upon a channel estimate of said plurality of signal components.

~~20.~~18. The receiver as claimed in Claim ~~19~~17, wherein said one or more decision modules comprises one or more hard decision modules.

~~21.~~19. The receiver as claimed in Claim ~~20~~17, wherein said one or more decision modules further comprises one or more soft decision modules.

~~22.~~20. The receiver as claimed in Claim ~~19~~17, wherein said reconstructing module is adapted to perform reconstruction based on a relationship between a received signal component and a transmitted signal.

~~23.~~21. The receiver as claimed in Claim ~~19~~17, wherein said reconstructing module is adapted to perform simultaneous reconstruction of two or more of said one or more signal components.

~~24.~~22. The receiver as claimed in Claim ~~19~~17, wherein said reconstructing module is adapted to perform reconstruction of said one or more signal components signal components one at a time.

~~25.~~23. A communication system comprising:

a signal reconstructing section for reducing noise in a transformed signal, said transformed signal having a plurality of signal components, said signal reconstructing section having:

a detector for detecting said transformed signal;

one or more decision modules, each of said one or more decision modules having an input coupled to output of said detector; and

a reconstructing module having one or more inputs, said one or more inputs being respectively coupled to output of said one or more decision modules,

wherein said reconstructing module is adapted to reconstruct one or more signal components of said plurality of signal components by a predetermined number of times to thereby form a noise-reduced transformed signal~~.~~;

wherein said reconstructing module is adapted to provide a reconstructed transformed signal of said transformed signal;

further wherein said reconstructing module is adapted to identify said one or more signal components based upon a channel estimate of said plurality of signal components.

~~26.~~24. The communication system as claimed in Claim ~~25~~23, wherein said one or more decision modules comprises one or more hard decision modules.

~~27.~~25. The communication system as claimed in Claim ~~26~~23, wherein said one or more decision modules further comprises one or more soft decision modules.

~~28.~~26. The communication system as claimed in Claim ~~25~~23, wherein said reconstructing module is adapted to perform reconstruction based on a relationship between a received signal component and a transmitted signal.

~~29.~~27. The communication system as claimed in Claim ~~25~~23, wherein said reconstructing module is adapted to perform simultaneous reconstruction of two or more of said one or more signal components.

~~30.~~28. The communication system as claimed in Claim ~~25~~23, wherein said reconstructing module is adapted to perform reconstruction of said one or more signal components signal components one at a time.

~~31.~~29. A signal reconstructing section for a receiver to reduce noise in a transformed signal, said transformed signal having a plurality of signal components, said signal reconstructing section comprising:

a detector for detecting said transformed signal;

one or more decision modules, each of said one or more decision modules having an input coupled to output of said detector;

and

a reconstructing module having one or more inputs, said one or more inputs being respectively coupled to output of said one or more decision modules,

wherein said reconstructing module is adapted to reconstruct one or more signal components of said plurality of signal components by a predetermined number of times to thereby form a noise-reduced transformed signal.

wherein said reconstructing module is adapted to provide a reconstructed transformed signal of said transformed signal;

further wherein said reconstructing module is adapted to identify said one or more signal components based upon a channel estimate of said plurality of signal components.

~~32.~~30. The signal reconstructing section as claimed in Claim ~~31~~29, wherein said one or more decision modules comprises one or more hard decision modules.

~~33.~~31. The signal reconstructing section as claimed in Claim ~~32~~29, wherein said one or more decision modules further comprises one or more soft decision modules.

~~34.~~32. The signal reconstructing section as claimed in Claim ~~31~~29, wherein said reconstructing module is adapted to perform reconstruction based on a relationship between a received signal component and a transmitted signal.

~~35.~~33. The signal reconstructing section as claimed in Claim ~~31~~29, wherein said reconstructing module is adapted to perform simultaneous reconstruction of two or more of said one or more signal components.

~~36.~~34. The signal reconstructing section as claimed in Claim ~~31~~29, wherein said reconstructing module is adapted to perform reconstruction of said one or more signal components signal components one at a time.